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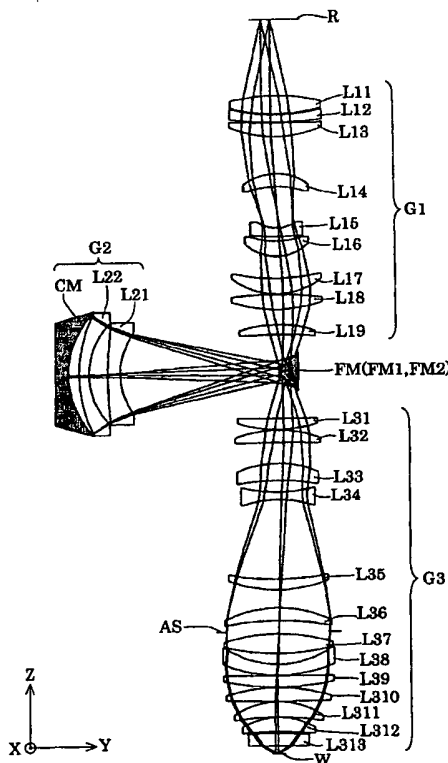
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(54) Title: PROJECTION OPTICAL SYSTEM AND EXPOSURE APPARATUS HAVING THE PROJECTION OPTICAL SYSTEM

(54) 発明の名称: 投影光学系および該投影光学系を備えた露光装置



(57) Abstract: A projection optical system having good optical performance without being substantially affected by birefringence even though an optical material having an intrinsic birefringence is used. The projection optical system forms the image on a first surface (R) on a second surface (W). Out of the transparent members constituting the projection optical system, 90% or more of the transparent members are made of crystals of cubic system. Out of all the transparent members, 70% or more of them satisfy the condition $P_n/E_n < 0.7$ where P_n is the diameter of the light beam coming from a point on the first surface and falling on each surface of each crystal transparent member and E_n is the effective diameter of each crystal transparent member, and the 70% or more of the transparent members are so arranged that the optical axis of each transparent member substantially agrees with the crystal axis [100].

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Biblio Page Drawing



PROJECTION OPTICAL SYSTEM AND EXPOSURE APPARATUS HAVING THE PROJECTION OPTICAL SYSTEM

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Cited Documents: EP0942297; JP2000128696; JP11021197; EP1115019; JP7072393; EP1114802; EP1063684

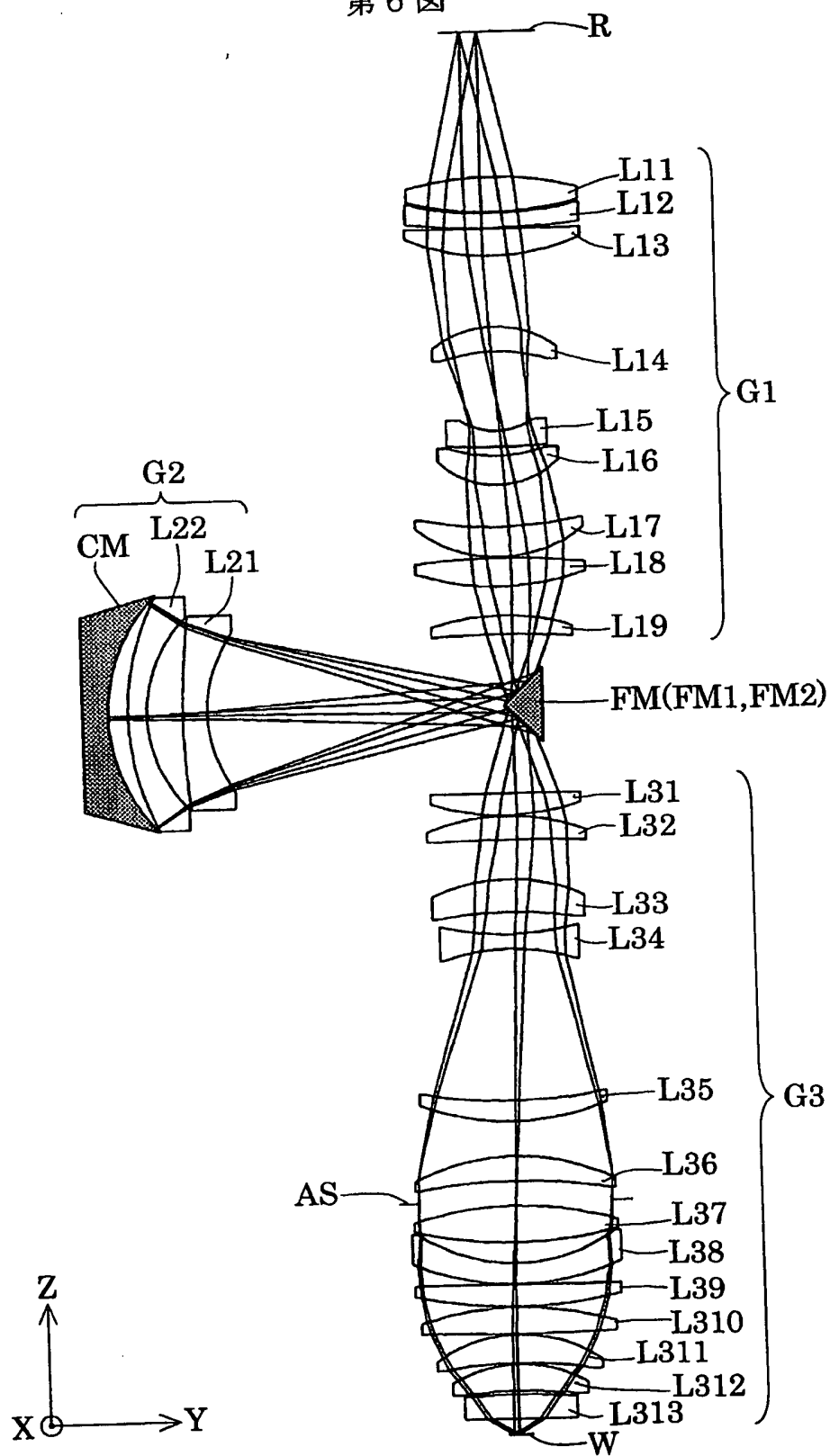
Abstract

A projection optical system having good optical performance without being substantially affected by birefringence even though an optical material having an intrinsic birefringence is used; The projection optical system forms the image on a first surface ∥ on a second surface ∥ W∥ Out of the transparent members constituting the projection optical system; 90% or more of the transparent members are made of crystals of cubic system; Out of all the transparent members; 70% or more of them satisfy the condition $P_n \leq E_n$ where P_n is the diameter of the light beam coming from a point on the first surface and falling on each surface of each crystal transparent member and E_n is the effective diameter of each crystal transparent member; and the 70% or more of the transparent members are so arranged that the optical axis of each transparent member substantially agrees with the crystal axis &sq; 100; .

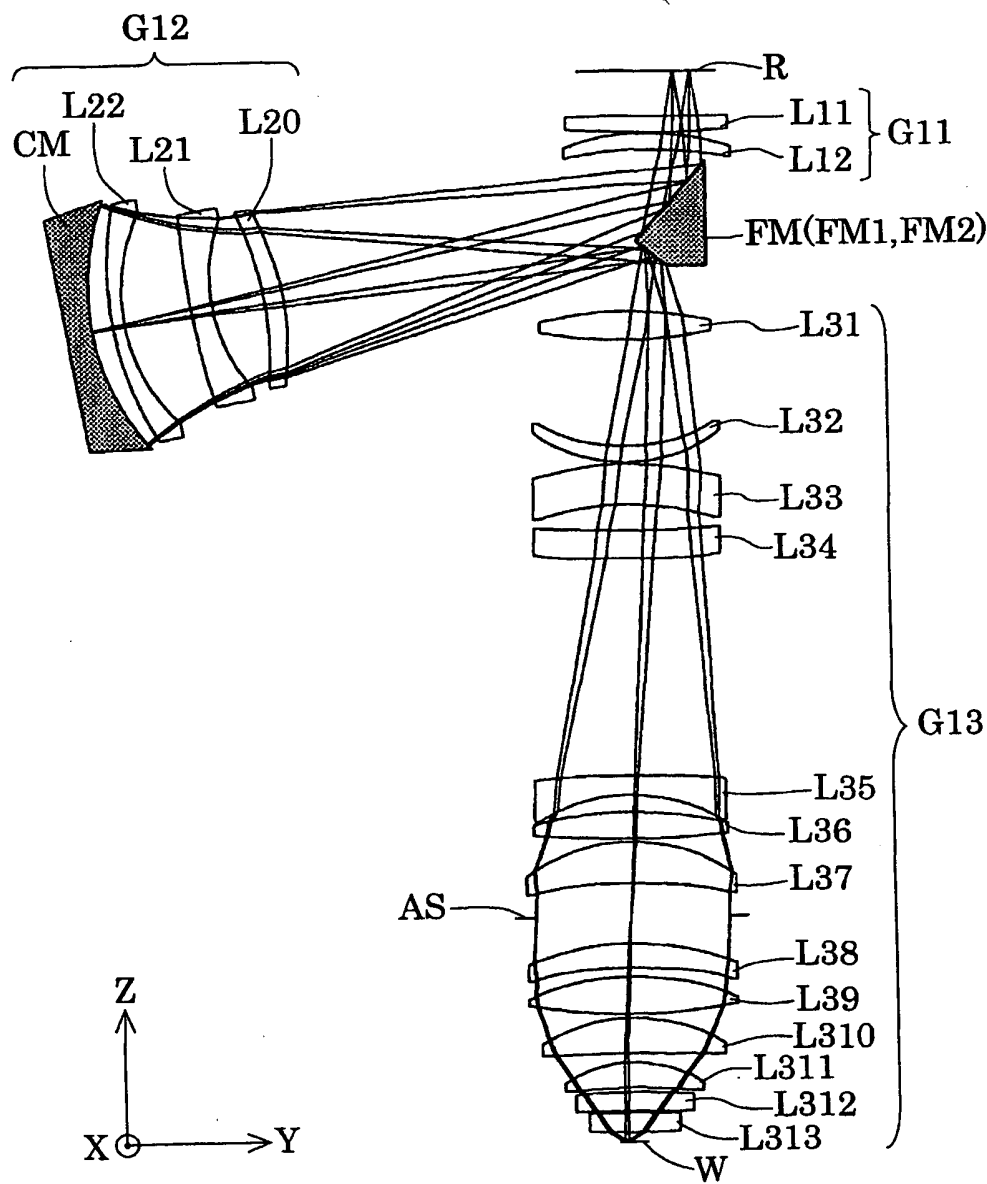
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第 6 図



第 8 図



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where D21 is the center thickness of the first negative lens L21 and D22 is the center thickness of the second negative lens L22.

The inventions of claims 6, 7 are the ones of independent claims referring to claim 5.

5.The invention of claim 8 relates to a projection optical system comprising transparent members and at least one reflecting mirror and adapted to form the image on a first surface on a second surface, characterized in that 90% or more of all the transparent members constituting the projection optical system are made of crystals of cubic system, the projection optical system further comprises a first lens group arranged in the optical path between the first and second surfaces, a first reflecting surface disposed in the optical path between the first lens group and the second surface, a second lens group disposed in the optical path between the first reflecting surface and the second surface and having a concave reflecting mirror and a round-trip optical system, a second reflecting surface disposed in the optical path between the second lens group and the second surface, a third lens group disposed in the optical path between the second reflecting surface and the second surface, and the first lens group has two transparent members in which the preset directions of specific crystal axes are substantially different.

The invention of claim 9 relates to a projection optical system comprising transparent members and at least one reflecting mirror and adapted to form the image on a first surface on a second surface, characterized in that 90% or more of all the transparent members constituting the projection optical system are made of crystals of cubic system, the projection optical system further comprises a first lens group arranged in the optical path between the first and second surfaces, a first reflecting surface disposed in the optical path between the first lens group and the second surface, a second lens group disposed in the optical path between the first reflecting surface and the second surface and having a concave reflecting mirror and a round-trip optical system, a second reflecting surface disposed in the optical path between the second lens group and the second surface, a third lens group disposed in the optical path between the second reflecting surface and the second surface along the linear optical axis.

a first-order intermediate image of the first surface is formed in the optical path between the second and third lens groups, and the first lens group has at least two transparent members made of the crystals.

Claims 10-12 are independent ones referring to any of claim 8 or 9.

Claims 13-15 are independent ones referring to any of claims 1-12.

However, the technique of fabricating 90% or more of all the transparent members constituting a projection optical system from crystals of cubic system is publicly known without especially citing prior art documents, and there are no technical features considered to be special technical features common to the groups 1., 2., 3., and (4 and 5).

The projection optical system comprising transparent members and at least one reflecting mirror and adapted to form the image on a first surface on a second surface, characterized in that 90% or more of all the transparent members constituting the projection optical system are made of crystals of cubic system, the projection optical system further comprises a first lens group arranged in the optical path between the first and second surfaces, a first reflecting surface disposed in the

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optical path between the first lens group and the second surface, a second lens group disposed in the optical path between the first reflecting surface and the second surface and having a concave reflecting mirror and a round-trip optical system, a second reflecting surface disposed in the optical path between the second lens group and the second surface, a third lens group disposed in the optical path between the second reflecting surface and the second surface is a conventionally known technique as disclosed in JP 2000-47114 A (Carl Zeiss Stiftung), 2000.02.18. Therefore, there are no common technical features considered to be special technical features among the groups 4. and 5.

Therefore, there are no common technical features among the groups of inventions within the meaning of PCT Rule 13.2, second sentence. Consequently, the groups of inventions are not so linked as to form a single general inventive concept.

Therefore, the groups of inventions do not comply with the requirement of unity of invention.